Thinking Like A Child: Restoring Primacy of Experience in Stimulating Creativity

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Abstract

An oft-touted *mantra* for creativity is: *think like a child.* We focus on one particular aspect of child-like thinking here, namely surface similarities. Developmental psychology has convincingly demonstrated, time and again, that younger children use surface similarities for categorization and related tasks; only as they grow older they start to consider functional and structural similarities. We consider examples of puzzles, research on creative problem solving, and two of our recent empirical studies to demonstrate how surface similarities can stimulate creative thinking. Based on this discussion, we propose an interactionist framework of cognition that distinguishes among the levels of experience, understanding and explanation, and posits top-down and bottom-up interaction mechanisms between adjacent levels. In this framework, we argue that to stimulate creativity, one needs to block the top-down mechanisms and facilitate bottom-up mechanisms so that alternative ways of understanding and explanation can be generated. In other words, we need to restore the primacy of experience. This also leads to the creation of a metaphorical connection between two conceptually different objects or situations (namely, the source and the target).

1. Introduction

In popular psychology, an oft-touted *mantra* for increasing creativity is: *think like a child* (Corner 2010, Ewedemi 2011, Greenwood 2009, Lehrer 2010). There is also empirical research demonstrating the effectiveness of this technique (Zabelina and Robinson 2010). We begin by examining one particular aspect of child-like thinking, namely the focus on surface similarities.

There is a large body of existing research showing that younger children tend to focus on perceptual or surface-level similarities (for example, shape or color) for categorization or for giving meaning to new words, and it is only as they get older they start to use functional, structural or other semantic similarities (Gentner 1988; Gentner and Ratterman 1991, Gottfried 1997; Imai, Gentner & Uchida 1994; Namy & Gentner 2002; Pierce & Gholson 1994; Siltanen 1989). There seems to be a general agreement on this, and the researchers have emphasized, time and again, how it is the functional and structural similarities

that are useful for reasoning and categorization, and surface similarities are often thought to be distracting (Faries & Sclossberg 1994), so we need not belabor this point here.

However, we would like to demonstrate that, at least for creativity, these structural and functional similarities form a severe handicap, and one needs to find ways to suppress them. We will make this argument in three ways: a) by discussing some examples of creativity puzzles, b) by reviewing research on creative problem solving, and c) by presenting two of our recent empirical studies that show how surface similarities can help stimulate creative thinking. We will conclude this part by arguing that this focus on surface similarities provides a concrete manifestation of *think-like-a-child* adage, for it basically urges one to think like the younger children as found in the similarity and categorization experiments.

Then we will present a framework for interaction between a cognitive agent and a world that distinguishes among three levels: experience, understanding and explanation. We will posit top-down and bottom-up mechanisms to connect these levels and identify conventions or habits as primarily top-down mechanism that inhibit creativity. We will argue that to facilitate creativity, one needs to block these top-down mechanisms to facilitate bottom-up mechanisms to restore the primacy of experience, which makes it possible to have alternate ways of understanding and explaining an experience. This process also often leads to creating new metaphorical connections between two conceptually different objects or situations.

2. Role of Surface Similarities in Stimulating Creativity

To highlight the role of surface similarities in stimulating creativity, we begin by considering some examples of creativity puzzles. This section is based on Indurkhya (2013a).

2.1 Some examples of creativity puzzles

Consider the problem shown in Fig. 1.

8809 = 6	5555 = 0	7111 = 0
8193 = 3	2172 = 0	8096 = 5
6666= 4	1012 = 1	1111 = 0
7777 = 0	3213 = 0	9999 = 4
7662 = 2	7756 = 1	9313 = 1
6855 = 3	0000 = 4	9881 = 5

2222 = 0 5531 = 0 3333 = 0

2581 = ??

Figure 1: A creativity puzzle

Unless you have already seen it before, it may take you quite a while to figure it out. One answer is 2, which is based on noticing that the number listed against each of the four-digit numbers is the number of circles (closed loops) in the four digits. In fact, the puzzle is usually accompanied by the following text:

> This problem can be solved by pre-school children in five to ten minutes, by programmers in an hour, and by people with higher education… well check it yourself![1]

This provides a very strong hint, for you have to rule out complicated mathematical relationships, and have to limit your search for operations familiar to a preschooler. But still many people find it difficult to ignore the many semantic and structural properties of the numbers, and the key to solving the puzzle is to think simpler; or to quote Wittgenstein, "Don't think, but look!"

Consider another example taken from the Mensa genius quiz book: *If jet has a value of 1, and plane has a value of 2, what is the value of Concorde?* (Grosswirth and Salny 1981, p. 97.) Here again, one's knowledge and semantic associations start to mislead. One correct answer is 3: jet has one letter used for vowels (a, e, i, o ,u), plane two, and Concorde three. There are many such examples, and one of the techniques for solving such problems is to deliberately avoid thinking about the problem in terms of semantic structures or familiar functions.

We should emphasize here that for most people it is very difficult to ignore the conceptual associations we have acquired in our lifetimes, and hence it is actually quite difficult to solve these 'simple' puzzles. This is perhaps best demonstrated by Suzuki and Hiraki's study (1997), where they asked the participants to solve the T-puzzle. This puzzle has four simple shapes, and the objective is to arrange them in the shape of the letter T (Fig. 2). They recorded the participants as they tried to solve this puzzle and noted that what makes it hard is that people seem to want to fill in one corner of a piece (labeled '*a'* in Fig. 3), which is actually an outside corner in the finished puzzle. This perceptual constraint perhaps comes because of our prior conditioning and is very difficult to ignore. So much so that people keep going in circles — keep trying the same combinations that did not work — and even

[1] http://motleynews.net/2012/03/24/can-you-solve-this-problem/ Accessed on Jan. 15, 2013.

when they are given the explicit hint that that particular corner is an outside corner, they still try to fill it in.

There are numerous such examples that are used in various creativity tests. Consider, for example, Guilford's (1967) alternative uses task, where the participants are asked to list different possible uses for a common item like a brick or a newspaper. In order to score high on this test, one needs to think differently, and not in terms of the structures and functions that are usually associated with the object. A slight variant on this is the *barometer question,* which has become more of an urban legend: How to measure the height of a building using a barometer? It is a high-school physics question, and the expected answer is to measure the atmospheric pressure at the top of the building and compare it with the pressure at the bottom of the building. But there are many other answers that score high on creativity: for example, using the barometer as a rock and timing its fall, using it as a weight at the end of a string to turn into a pendulum and measuring acceleration due to gravity, using the pendulum as a ruler, and so on. Most of these answers are based on focusing on surface features of the barometer, and deliberately ignoring its structural and functional features.

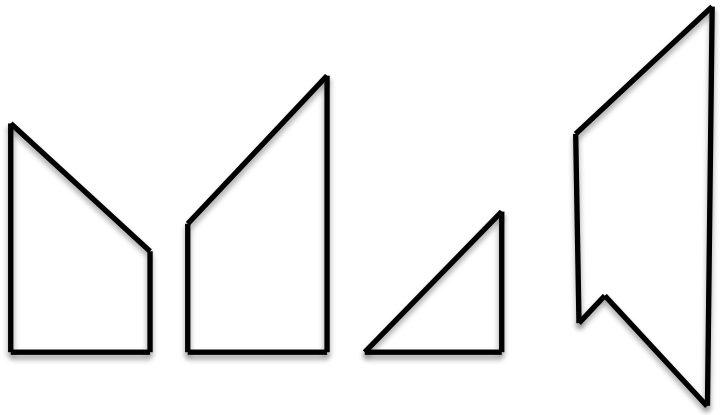


Figure 2: The T-puzzle. The goal is to arrange these pieces in the shape of letter T

Given that perceptual and surface similarities provide the fodder for puzzles and such, and structural and conceptual associations serve only as distractions and decoys, let us now look at the situation for real-world problem solving when creativity is called for.

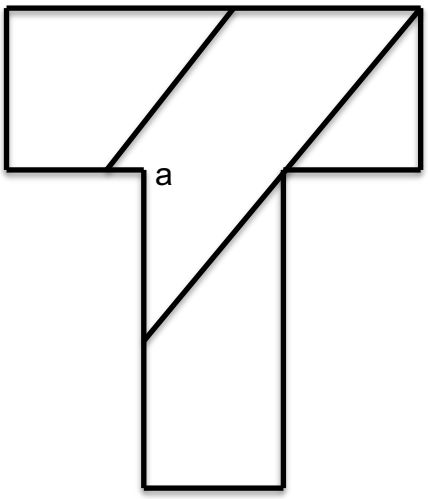


Figure 3: Completed T-puzzle. Notice that the corner ‘a’ is on the outside.

2.2 Research on creative problem solving

Research on creative problem solving has also emphasized that to get a creative insight one needs to move away from the existing conceptual structure, and its related semantic associations, of an object or a situation. We should emphasize here two unique aspects of *creative* problem solving. One is that the problem seems hard in that one has already tried to solve it through its existing representation and conceptualization and failed. Hence, some unusual approach is called for. The other is that it is not clear if a solution to the problem exists. These two features make creative problem solving quite a different cup of tea from the conventional problem solving. There have been many studies where the participants are asked to solve some math or physics problems, the solutions of which are known to the experimenter, and then the effects of priming or exposure to an analogous problem are measured. (See, for instance, Novick and Holyoak 1991.) Such studies do not illuminate the real-world creative problem-solving process.

Studies of real-world problem solving (de Bono 1975; Gordon 1961; Schön 1963), on the other hand, provide us a glimpse of mechanisms underlying creativity. They all recognize that the crux of creativity is to move away from the existing conceptualization of the object or the situation. They also acknowledge that it is difficult for people to ignore the conceptual associations that an object almost automatically brings to mind. Generally, two techniques are suggested to break away from the

conventional way of thinking. One is to juxtapose the target object or situation with an unrelated object or situation: this is sometimes referred to as *making the familiar strange* (Gordon 1961). The other is to focus on the surface features of the object or situation: so as to deliberately not think of it conceptually, structurally or functionally, but to focus on its perceptual or surface features. This is sometimes called *deconceptualization* (Rodari 1996).

That deconceptualization plays a major role in creativity is supported by many real-world cases where accidentally noticing surface similarities between two objects or situations suggested a novel idea that later led to a major innovation. One such example is how Ignaz Semmelweis came up with the idea of the germ theory. (See, for instance, Levitt & Dubner 2009.) When Semmelweis was practicing (in the 1840s) at the Vienna General Hospital in Austria, there was no knowledge of bacteria and germs. Many women used to die during childbirth due to puerperal sepsis (childbed fever). Between the two maternity wards at this hospital, the death rate in one of them was more than six times higher than the other one. There were many speculative theories for the childbed fever, like foul air in the delivery wards, the presence of male doctors, which violated the modesty of mothers, and so on. None of these explained the difference between the mortality rates between the two wards.

The insight came when one professor, who was helping a student with an autopsy, received an accidental cut on his finger and died from the resulting infection. Semmelweis noticed that the symptoms were similar to the childbed fever victims. (These were all surface similarities, for there was no structural knowledge connecting the two situations.) A deeper investigation and some more research led him to formulate a theory of germs, according to which the germs from cadavers were the cause of the childbed fever, and the simple technique of washing hands in chlorinated water before handling the patient in the maternity ward brought down the fatality rate.

We list below a number of techniques, including the two mentioned above, that various researchers have proposed for stimulating real-world creative problem solving:

- *Making the Familiar Strange:* Gordon and his colleagues (1961) studied creative problem solving in real-life situations for many years and found that one way to get a new perspective on the target problem is to look at in a *strange* way. The mechanism they proposed is to juxtapose the target problem or object with a completely unrelated object or situation.
- *New Combination:* Haefele (1962) characterized creativity as: "A *new combination* formed from pieces already in the mind by symbolic manipulation during dissociated thought." (p. 5)

He also delineated four dynamic stages, namely preparation, incubation, insight and verification in creative thinking.

- *Displacement of Concepts:* Schön (1963) argued that in order to get a new insight about a concept it needs to be *displaced,* that is, put in the context of other unrelated concepts. He emphasized that the most important step in problem solving is *problem setting,* that is how the problem is stated and viewed, and metaphors play a key role in this step.
- *Bisociation:* Koestler (1964) coined this term to emphasize that the pattern underlying a creative act is the perception of a situation or an idea in two self-consistent but habitually incompatible frames of reference.
- *Lateral Thinking:* Edward de Bono (1975) contrasted vertical thinking with lateral thinking. In the former, one starts with some assumptions and explores their implications deeper and deeper. But in lateral thinking, the goal is to look at the problem in different ways so that the familiar assumptions one makes about it can be questioned and perhaps a new set of assumptions can be brought in.
- *Estrangement:* Rodari (1996) focused on creativity in inventing stories and proposed many practical methods that stimulate imagination and creativity in children (and in adults). Many of his methods rely on random juxtaposition of concepts. One mechanism he emphasizes as the first step in creating riddles is *estrangement,* where you are asked to see the object as if for the first time. In other words, instead of seeing the object in terms of the familiar categories it naturally evokes, you are asked to consciously block this evocation and try to view the object as if it is a strange object you are seeing for the first time.
- *Conceptual Blending:* Fauconnier and Turner (2002) analyzed how people combine perceptual, experiential and conceptual aspects of different concepts subconsciously to generate new insights.
- *Psychological Distance:* Shapira and Liberman (2009) suggest *psychological distance* as a mechanism for enhancing creativity. They and their colleagues (Jia, Hirt and Carpen 2009) have demonstrated that psychological distance can be induced by such simple devices as taking another person's perspective or thinking of the problem as if it is unreal.

Though each of these mechanisms has its own peculiarities, they all emphasize that:

- In order to get a new insight about an object or a situation, we need to conceptualize it anew and differently.

- A pre-requisite to this is to get away from (or break) its existing conceptualization.
- This is difficult because many of these associations are habitually and automatically recalled and they pull us into a sort of cognitive rut.
- Focusing on surface similarities is one technique that can be used to break away from this cognitive rut. (See also, Indurkhya 2010; 2013).

With this background, we now describe two empirical studies that highlight the role of surface similarities in stimulating creativity.

2.3 Empirical support for the role of surface similarities in stimulating creativity

In our past research, we have a conducted a number of studies to assess the role of surface similarities in stimulating creativity (Indurkhya & Ogawa 2012; Indurkhya & Ojha 2013; Ojha & Indurkhya 2009; Ojha & Indurkhya 2016). We briefly summarize here the results of two such studies.

2.3.1 Role of algorithmic perceptual similarity in visual metaphors and emergence of features

One of the research problems we have been working on is to assess the role of low-level perceptual similarities — namely similarities with respect to shape, color, texture, etc. — on emergent features when two images are juxtaposed. A feature related to a metaphor is considered *emergent* if it is not normally related to either of the two terms of the metaphor alone. For example, in "Her gaze, a flash of diamond", 'seduction' is an emergent feature as it is not normally related to 'gaze' or 'diamond' (Gineste, Scart & Indurkhya 2000). A major methodological problem in working with images is in determining the degree of low-level perceptual similarities between two given pictures. One alternative is to ask the participants to rate the degree of perceptual similarities between pairs of pictures, but the drawback is that when we look at a picture, conceptual and perceptual features interact heavily and it is difficult to be certain that only perceptual features were used in determining the degree of similarity. To address this problem, we turned to image-processing programs.

In the field of machine vision, a number of algorithms have been developed for low-level visual processing. These algorithms extract features (like color, shape, texture, and so on) of images, which are analogous to features found in the early stages of visual processing in humans. We considered that a similarity measure based on these features would reflect perceptual similarity.

We used one such image-based search system called Fast Image Search in Huge Database (FISH), which compares two images based on low-level perceptual features like color, shapes, texture, etc., to

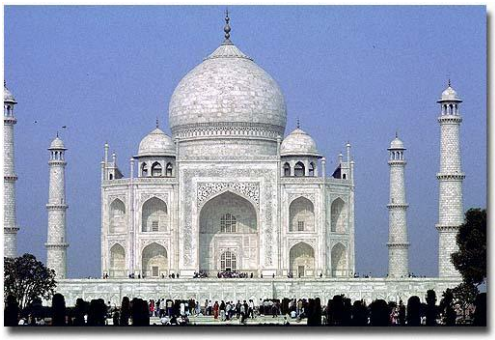
get a similarity index for them (Tandon et. al., 2008). We refer to this as *algorithmic perceptual similarity*. For example, consider the pair of images shown in Fig. 4. The image on the left is of the world-famous marble mausoleum *Taj Mahal* that was built by the Moghul emperor Shah Jahan in the 17th century. The image on the right is of wine bottles. These two images were given a high perceptual similarity index by the FISH system. In fact, the wine bottles image was retrieved by the system as a *similar* image when queried by the *Taj Mahal* image. If we examine them carefully, we can see the perceptual similarities: the tall slender minarets of the *Taj Mahal* are analogous to the shape of the wine bottles. However, when people look at these two images, they tend to focus on conceptual features, and generally do not find these images similar at all.

Using such stimuli, we experimentally studied how perceptual similarities correlate with people's ability to interpret pairs of images metaphorically, and with emergence of new features that are not a part of either image (Ojha & Indurkhya 2009). Our results show that a pair of perceptually similar images (in terms of color, shape, etc.) is more likely to be given a metaphorical interpretation. Here are some examples of the interpretations given to the pair of images in Fig. 4 by the participants: 'Becomes better as it grows old', 'Standing pillars of tradition', 'Beauty in taste', 'Taste of history', 'Taj for eyes, wine for tongue', 'What a waste of time.' We also found that perceptual similarity correlates positively with emergent features.

Figure 4: An example of algorithmic perceptual similarity

2.3.2 Creativity in generating visual arts

In another study, which was a collaborative work with a visual artist (Indurkhya & Ogawa 2012), we focused on the creative process involved in connecting two pictures by painting another picture in the middle in such a way that the trio of pictures forms one smooth portrait. This technique was involved in four *Infinite Landscape* workshops conducted at art museums in Japan and Europe by the artist over the last five years. Based on the artist's verbal recollection of the ideas that occurred to him as he drew each



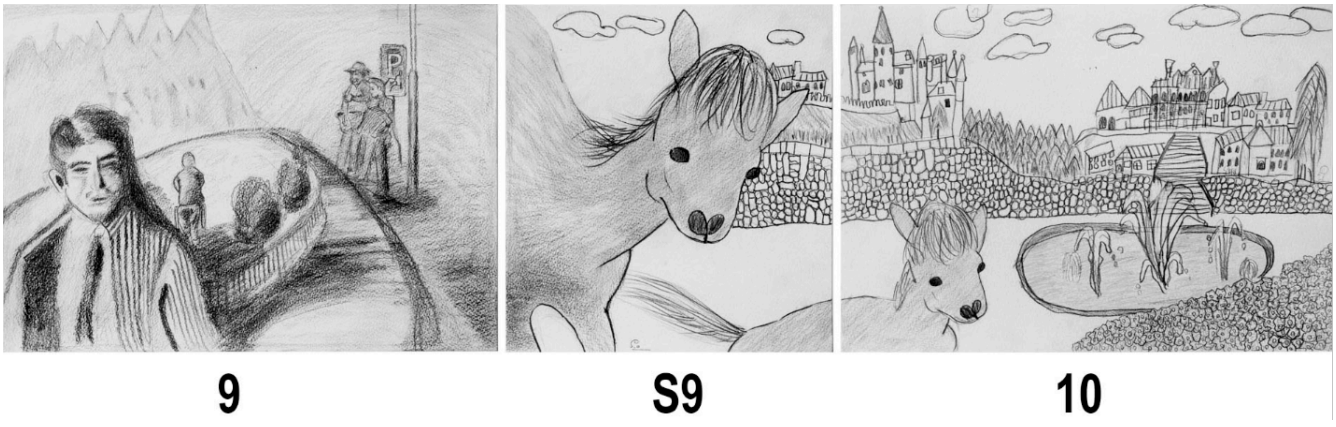
of the connecting pictures, we identified the micro-processes and cognitive mechanisms underlying the genesis of these ideas, and surface similarities with respect to shading, texture and shape were found to play a key role in it.

One such trio of pictures is shown in Fig. 5. Here the pictures (9) and (10) were drawn by participants, and the artist drew the middle picture S9. The artist recorded the following thoughts on how he came up with the idea for S9 (the artist's original comments were in Japanese and are translated here with minor editing by the author): "These two had completely different atmosphere from each other. Sketch 9, drawn by an adult participant, is a scene set at dusk; a person looking at the artist is drawn wearing a sad expression. Sketch 10 has a bright atmosphere with flowers, fountains, buildings on a hill, and a horse. Moreover, each picture had an important character in the bottom left. The idea for connecting these sketches came to me while looking at the wonderful horse in 10. I thought of putting a parent horse running nearby. Because the background color of 9 and the body color of the horse in 10 was the same, I transformed the background of 9 into the parent horse in S9, which became a nested image structure. Then I extended the baby horse and the hill with the buildings.

Figure 5: A trio of pictures from *Infinite Landscape* workshop

Here the same shading for the horse's body in 10 and the background in 9 led to the idea that the background in 9 can be morphed into the mother horse in S9, which resulted in an Escher-like nesting of pictures. Thus, this study provides empirical support for the role of surface similarities in generating new ideas.

In this task, viewing the object in terms of (or juxtaposing it with) another unrelated object can be a key heuristic. In order to elaborate this further, we first outline a model of explanation, understanding and experience.



Having emphasized the role of surface similarity in stimulating creativity, we now turn to explaining this within an interactionist view of cognition.

3. Creativity in an interactionist framework for cognition

The interactionist framework of cognition hypothesizes that cognitive structures emerge through an interaction between a cognitive agent and its environment: cognitive structures are not pre-determined by the agent or the world alone but are generated through a collaboration between the two. There are numerous works that elaborate this framework and provide supporting evidence (Indurkhya 1992, 2006; O'Regan & Noë 2001; Sangoi 2012). In this section, we seek to explain the role of surface similarities in stimulating creativity within this framework.

3.1 Levels of experience, understanding and explanation

The protagonist in Saul Bellow's *Mr. Sammler's planet* laments, "Everyone wants to *explain* everything, but *understand* nothing." (Emphasis added.) The idea expressed here is that people try very hard to explain things, which precludes understanding. In other words, understanding is more basic, and focusing too much on trying to explain a situation prevents one from fully understanding it.

We propose to add another level to this by claiming: Everyone wants to *understand* everything, but *experience* nothing. This expresses the idea that focusing too much on understanding a situation prevents one from fully experiencing it.

These three levels of interaction between a cognitive agent and the world can be elaborated as follows.

- ***Experience:*** This is the primordial level at which a cognitive agent interacts with the world. Experience refers to immediate perceptual awareness and is intensely personal and subjective. It largely focuses on sensorimotor attributes and visceral aspects of the experience.
- ***Understanding:*** Understanding occurs when the experience is incorporated into some internal model by relating to past experiences. At this level, the agent tries to interrelate different aspects of the current experience and connect them with aspects of previous experiences. Thus, it focuses on the relational aspects of the current experience. It is still subjective, internalized in some kind of private language, and is meaningful to the agent in a personal way.
- ***Explanation:*** We get to the explanation level when the experience and the understanding are formulated in a language or some other communication medium so that it can be shared. Explanations are in terms of causes and effects, so this level involves causal relations. This is

the external manifestation of the experience, still from the agent's subjective point of view, but expressed in public language and is shared.

To summarize, experience is understood, and understanding is communicated through explanations. These three levels of interaction are shown graphically in Fig. 6. What is important is that the flow of information between these three levels proceeds in both directions. Though experience leads to understanding, prior understandings effect experience. Similarly, though understanding leads to explanation, prior explanations effect understanding. Often, the influence of experience on understanding, and the influence of understanding on explanation is referred to as bottom-up processing, and the influence of explanation on understanding, and the influence of understanding on experience is referred to as top-down processing.

In this interactionist model of cognition, conceptual understanding of the world (or the environment) is seen to arise as a result of an interaction between concepts and percepts. The origin of this view can be traced to Kant, who argued against purely empirical accounts (purely bottom-up processing), such as John Locke, and also against purely conceptual accounts (purely top-down processing), such as Plato, to conclude that concepts without percepts are empty, and percepts without concepts are blind. Later on, Cassirer argued that a multiplicity of symbolic systems (or worlds) is possible, and that they might not be reducible to one another. (See also Goodman 1978.) Gestalt psychologists showed that mind imposes its own organization on the perceptual stimuli. Piaget provided further evidence that cognition is a constructive process in which a cognitive agent structures the world based on its actual and potential actions. (See also Indurkhya 1992; O'Regan 2001).

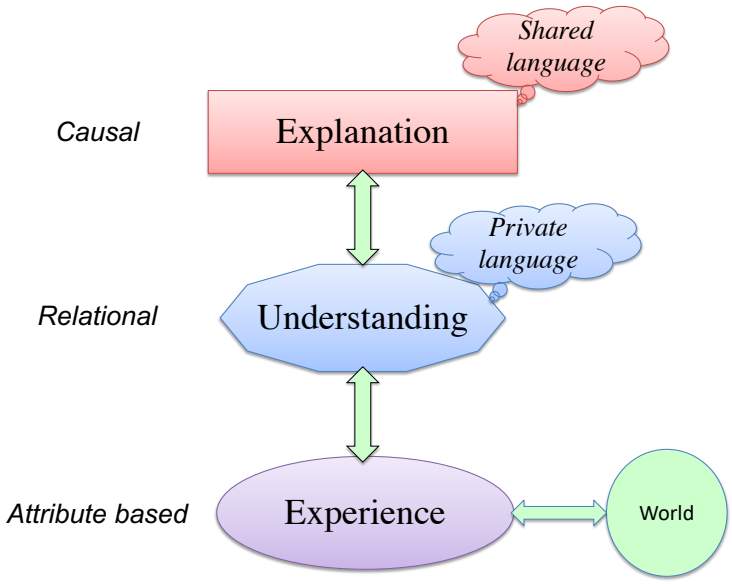


Fig. 6: Three levels of interaction

Many researchers have shown that one's beliefs and expectations have a remarkable influence on one's perception. For example, Lang *et al.* (1975) showed that the aggressive behavior of participants after drinking was affected by what they thought they were drinking rather that what they actually drank. Brochet (2001) found similar effect with wine tasting: the participants' perception of taste depended on the bottle from which the wine was poured, even though it was the same wine. All this points to the fact that our expectations, past experience, and understanding influences our perception. This results in a top-down influence that biases our current experience based on our past understandings and explanations.

3.2 Top-down influences due to cultural factors and habits

When we are having a particular experience, our cultural conditioning, previous experiences and habits almost always bias us towards a certain mode of understanding and certain explanation. Given an experience, we habitually understand in a certain way; and given an understanding, we habitually explain it in a certain way. In the process, however, alternate ways of understanding and explanation are lost. This is illustrated in Fig. 7. For an experience, once a particular understanding is chosen (U2), and a particular explanation is chosen (E3), the alternative ways for understanding (U1, U3 and U4) and alternative explanations (E1, E2, E4 and E5) are lost. This is essentially the point which Mr. Sammler was lamenting.

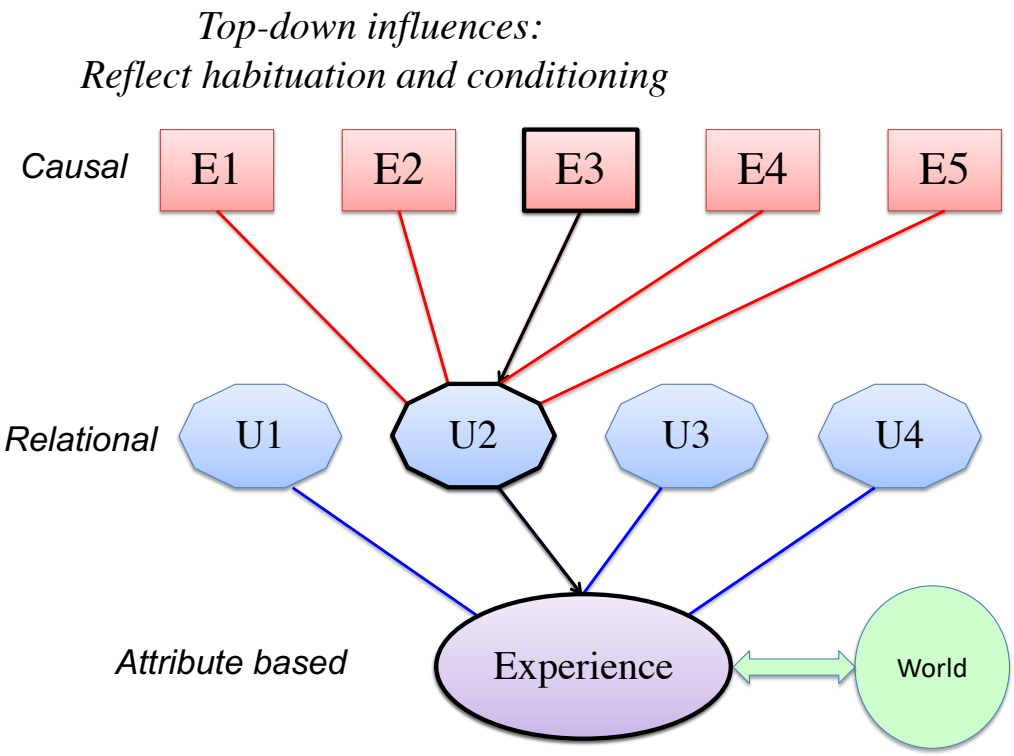


Fig. 7: Top-down influences reflect habituation and conditioning

Another thing to notice is that as we go from experience to understanding and to explanation, there is invariably a loss of information. This loss of information can be described in the following way. As we mentioned above, an experience can be understood in many ways, and an understanding can be explained in different ways. When we understand an experience in one way, some aspects of the experience are chosen and incorporated in the understanding. But at the same time, some other aspects of the experience, which could possibly lead to another way of understanding that experience, are ignored. Thus, from the point of view of understanding (U2 in Fig. 6), these ignored features are lost. For example, when an object is described as a 'chair', many specific properties of that chair, like its color, style, kind of material etc. are lost. Of course, we could make our conceptualization of the object more specific — it is a red chair, made of teak, with a high back, and so on — but no matter how detailed the conceptual representation is made, there is always some aspects of the object that are excluded, and it is these excluded aspects that constitute the *information lost in the conceptualization.* (This is the theme of a short story *Del Rigor en la Ciencia (On Exactitude in Science)*, by Jorge Luis Borges and Adolfo Casares, 1946.)

3.3 Crux of Creativity: Re-conceptualization and restoring primacy of experience

The information lost in the habitual conceptualization is something that perhaps was not relevant to the cognitive agent (or to the society of the cognitive agents) in their past interactions. However, this lost information may be crucial to solve a new problem, and then the habitual understanding and explanations become hopelessly inadequate because they do not have this information. In order to recover some of this lost information, one needs to understand and explain the experience in a different way, and therein lies the key to creativity. For this, we must undo the effects of top-down conditioning, move closer to perception, and focus on the experience (Fig. 8). As we mentioned above, this is a cognitively difficult task, for we are strongly conditioned by our culture and habits, and it is not so easy to break away from it. Approaches such as meditation that focus on current sensation (and not on the past or the future), art lessons that focus on seeing lines, shapes, shadows and colors (and not objects and people) or listening to the sounds (instead of meanings), metaphors that force one to make inter-domain or cross-modal connections, are all designed to help overcome this bias and conditioning.

When we focus on the experience itself, without trying to understand or explain it, it frees one's mind from the habitual conditioning, and the experience can be reconceptualized, re-understood and re-explained in alternate ways. It should be noted that this process of reconceptualization will invariably lose some aspects of the experience too, but it may reveal some other aspects of the experience that were lost in the conventional conceptualization. In other words, it may recover some of the information that was lost in the habitual understanding and explanation. This can be useful for aesthetic pleasure, in art and poetry; for making new artifacts, in science and technology; or for achieving some desired situation, in problem solving. This, in the framework we are proposing here, is the crux of creativity. (See also Indurkhya 1999; 2006; 2010.)

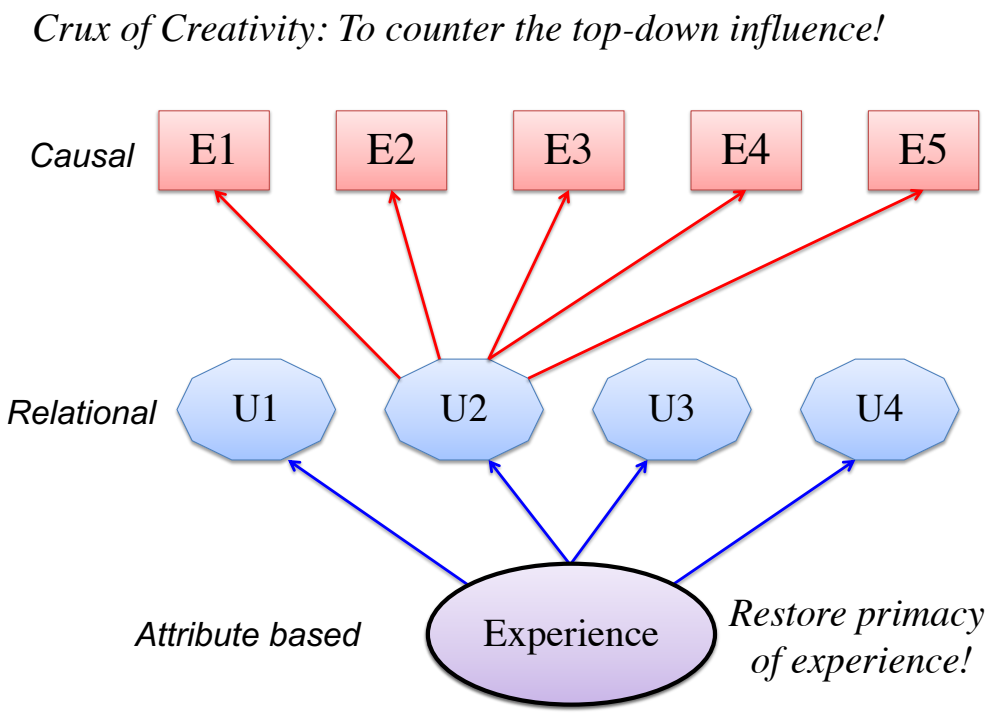


Fig. 8: Crux of Creativity: Counter top-down influence and *restore primacy of experience!*

4. Conclusions: Thinking like a child and creativity

We now return to the main theme of this paper, namely what does it mean to *think like a child* for stimulating creativity. First let us consider the role of surface features. If we look at the perspective from developmental psychology, the progression from surface features to structural features can be explained as follows. As children grow older, they acquire more knowledge of the world and, more importantly, more knowledge of social norms and conventions. This knowledge takes the form of semantic structures and relationships, and over time, they rely more on these relationships, and surface similarities take a back seat. But as a child gets habituated to some semantic structures, a horde of alternate possible semantic structures get lost. A major part of creativity consists in reclaiming some of these alternate semantic structures — or what Nelson Goodman (1978) would call 'worlds' — that might have been. Focusing on surface similarities provides one mechanisms to go back to the pre-structure stage, so that alternate structures can be found.

The shift from surface features to structural features also underlies a shift from experience to understanding and to explanation. Infants live in the immediacy of experiential world, without worrying

about where the next feeding will come from. But as they develop cognitively, they connect their experiences together, acquire concepts, form models of understanding, and eventually learn to describe and explain their experiences. At some stage, they learn to experience the world at a conceptual level, in terms of understanding and explanations, thereby losing awareness of many aspects of experiences. It is interesting to note that this may also lead to stress and anxiety and many therapy techniques work by bringing the focus back on the immediacy of experience, like an infant.

It is also interesting to point out that this aspect of surface similarities to create new insights is one of the advantages claimed for the case-based reasoning approach. For instance, Riesbeck and Schank (1989, pp. 9-14) compare and contrast three modes of reasoning: 1) reasoning with ossified cases (rules or abstract principles), 2) reasoning with paradigmatic cases (cases with a given interpretation), and 3) reasoning with stories (cases with many possible interpretations and capable of re-interpretations). They argue that it is the third mode of reasoning that displays the most flexibility and power of having a knowledge base containing cases. But in reasoning with stories, one essentially relies on surface similarities, and constructs alternate structures on the fly as needed. Indeed, it has also been noted that surface similarities play a key role in memory access and recall (Barnden & Holyoak 1994).

This aspect of surface similarities is also crucial in generating new metaphors. When two different objects or situations are brought together based on surface similarities between them, this often leads to making a novel metaphorical connection between them (Indurkhya & Ojha 2013; Ojha & Indurkhya 2016; Rodari 1996).

To sum up, we have argued that restoring the primacy of experience is the key factor underlying thinking-like-a-child approach to stimulating creativity. In this regard, focusing on surface features and surface similarities facilitates moving away from the conceptual rut and getting closer to the experiential level, which in turn leads to alternative modes of understanding and explanations. Needless to say, much more work remains to be done in exploring how surface similarities generate alternate semantic structures (see, for example, Schwering *et al.* 2009). We are also exploring ways to design and experiment with creativity stimulating systems that are based on surface similarities (Indurkhya 2015; Ojha and Indurkhya, to appear; Stojanov and Indurkhya 2014.)

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